Attorney Docket: 622/42052DV
PATENT

#33
9.13.02

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: PIUS GRUENENFELDER ET AL.

Serial No.: 08/902,331 Group Art Unit: 1753

Filed: JULY 29, 1997 Examiner: G. CANTELMO

Title: MAGNETRON ATOMIZATION SOURCE AND METHOD OF USE THEREOF

APPEAL BRIEF

Commissioner for Patents
Washington, D.C. 20231

Sir:

The following Appeal Brief is submitted herewith in triplicate in accordance with 37 CFR § 1.192 along with the requisite fee of $320.00 set forth in 37 CFR § 1.17(c).

Real Party in Interest

Unaxis Balzers AG of Fuerstentum, Liechtenstein.

Status of Claims

This is a divisional application filed pursuant to 37 CFR § 1.60 in which Claims 34-43 were substituted by preliminary amendment for the parent application Claims 1-33.

Claims 44 and 45 were subsequently added, and Claims 34 and 38-43 deleted by amendment.

No claims have been allowed. Claims 35-37, 44 and 45 (Appendix A) are on appeal. Claim 45, as rewritten to correct the misspelling of "workpiece" is the version used in Appendix A.

Status of Amendments

An after-final amendment was filed on September 3, 2002 to address the above-mentioned objection to Claim 45.

Summary of the Invention

[Page and line numbers in parenthesis refer to the Specification.]

The present invention relates to a magnetron atomization source having a tapered target body with a mirror-symmetrical, concavely constructed atomization surface with respect to at least one plane. (Page 1, lines 3-6.)

The present invention eliminates disadvantages encountered in the prior art with regard to yield and the like and improves efficiency by providing that the process space, apart from the receiving opening for the at least one workpiece, is bounded essentially by the atomization surface. The surrounding non-atomized residual interior surface is reduced to a respective minimum which, during atomization operation, ensures a stable plasma discharge. (Page 5, lines 5-14.)

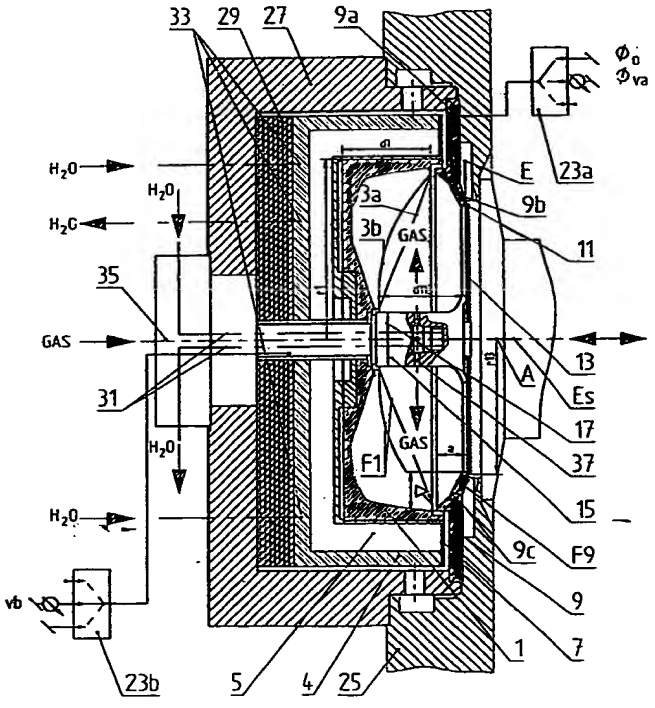
As a result of the fact that the atomization surface of the tapered target body essentially defines the process space, apart from the workpiece placed during the operation, a significant improvement of the ratio between the atomized-off material quantity and the material quantity deposited as a layer on

the workpiece or the workpieces is achieved and results in a significant efficiency increase. (Page 5, lines 15-22.)

Preferred surface ratios are obtained making the relationship of the residual interior surface, such as that of the receiving ring, and that of the atomization surface of the tapered target body are such that the former is less than or equal to 50% of the latter. (Page 5, line 23-Page 6, line 3.)

The magnetron atomization source shown in Fig. 1 below includes a tapered target body 1 (shown in red) having, in a new condition, a conical atomization surface 3a, or a concave mirror shape 3b, preferably in the shape of a calotte shell, so that, already in its new condition with an atomization surface F_1, the target body 1 is significantly thicker at the edge than in the center. (Page 6, lines 15-22.)

FIG.1



The maximal thickness, d_1, of the target body 1 on its edge amounts to approximately 50% of the target radius r_1. The target body 1 is embedded in a ferromagnetic cup-shaped magnetic circuit housing 4 (yellow) which defines a cup-shaped magnet receiving space 5 which encloses the target body 1 on the base side and on its upward-projecting lateral surfaces. A surrounding receiving frame 9 (blue) is provided along the edge of the target body 1 and of the circular-ring-shaped end face 7 of the magnetic circuit housing 4 and is electrically insulated from the target body 1 as well as the housing 4 at a dark space distance. The interior surface F_9 of the receiving frame 9 projects in a sloped manner from the edge of the target body 1 against the center axis A of the source inward and defines a receiving opening 11 for a circular workpiece disk 13. In the illustrated embodiment, the ratio of the surface F_9 to the new atomization surface F_1 is:

$$F_9 \leq 30\% \, F_1.$$

(Page 7, line 12- Page 8, line 3).

The circular workpiece disk 13 (thick black line) is preferably a dielectric or metallic workpiece disk, preferably the body of a storage disk to be coated, such as a magneto-optical storage disk, a video disk, an audio disk such as a compact disk or CD. The periphery of the disk 13 rests at the edge of the receiving opening 11 on the receiving frame 9 which, particularly in the case of CD processing, forms the peripheral masking element in order to prevent an atomization coating at the edge of the disk and to obtain a transition which is as sharp as possible from the coated surface to the uncoated edge. (Page 8, lines 4-14.)

The center of the target body 1 can be penetrated by a core 15, which is electrically insulated with respect thereto. For CD-coating and for coating most other optical storage disks, the core 15 extends to the level of the receiving opening plane E in order to mask the center of the workpiece disk 13. If unnecessary for masking or the like, the core 15, as indicated by the end surface 17, may be reduced in height or eliminated completely. (Page 8, line 15-24.)

The target body 1 is placed by the magnetic circuit housing 4 on a negative cathodic potential. As indicated schematically by the selection units 23a, 23b, the core 15 as well as the receiving ring 9 can be applied to the anode, such as the ground potential Φ_o or to adjustable or fixedly given other reference potentials Φ_v or can each be operated in a floating manner. Preferably, the core 15 and the ring 9 are applied to anodic potentials. (Page 9, lines 1-8.)

With a circular workpiece disk 13 having a radius r_{13}, corresponding to a diameter ϕ 13 = $2r_{13}$, the following dimensioning of the maximal distance of the new atomization surface to the disk surface d_{113} to be coated has proven to be excellent:

$$d_{113} \geq 20\% \, \phi_{13},$$

wherein the distance d_{113}, particularly in the case of normal pressure conditions of 10^{-3} to 10^{-1} mbar during atomization coating, should not significantly fall below 25 mm.

Furthermore, the following dimensioning will preferably apply: generally, $d_{113} \leq 50\% \, \phi_{13}$, but preferably: $d_{113} \leq 42\% \, \phi_{13}$, and most preferably, $d_{113} \leq 50\% \, \phi_{13}$. (Page 9, line 15-Page 10, line 3.)

The foregoing dimensioning is particularly true for the processing of circular-disk-shaped workpieces of diameters of from 50 mm to 150 mm, particularly 75 mm to 150 mm. If, however, the workpieces to be coated are not of circular-disk-shape but, for example, are oval or rectangular, the indicated dimensioning directions with apply relative to the smallest diameter ϕ_k of the respective workpiece. Furthermore, it has been found to be preferable, particularly for CD-coating according to Fig. 1, that the target body radius r_1 is 30% to 40% larger than the radius r_{13} of the workpiece disk 13 to be coated. (Page 10, lines 4-14.)

The distance Δ, which is perpendicular with respect to the axis A or generally with respect to a plane of symmetry E_s and is bridged or spanned by the surface F_9, amounts, relative to the diameter ϕ_{13} of a circular disk 13 or, more generally, with respect to the smallest diameter Φ_k of a non-circular disk, as defined above, to, generally $\Delta \leq 20\%\ \phi_{13}$, but preferably to $\Delta \leq 10\%\ \phi_{13}$, and currently is most preferably dimensioned at $\Delta \approx 15\%\ \phi_{13}$. The distance Δ can also be selected to be zero. That is, the interior surface F_9 is configured to have only components parallel to the axis A or the plane E_s. (Page 10, lines 22-Page 11, line 7.)

The distance, a, bridged or spanned by the interior surface F_9, parallel to the axis A or the plane E_s, irrespective of whether Δ is or is not larger than zero, and relative to the distance d_{113} between the new atomization surface center and the disk surface to be coated, amounts to, generally, $0 \leq a \leq 50\%\ d_{113}$, but preferably to $0 \leq a \leq 40\%\ d_{113}$, and is currently most preferably dimensioned at $a \approx 30\%\ d_{113}$. (Page 11, lines 8-15.)

Furthermore, a system-side flange 25 is provided for mounting the source according to the present invention. An electric insulation 29 is provided between a source housing 27 with the flange 25 and the magnetic circuit/target body arrangement comprising the housing 4 and the target body 1. In addition, as illustrated schematically, the centric core 15 is medium-cooled, preferably water-cooled, by way of a pipe system 31. The cooling of the receiving frame 9 takes place by way of the flange 25. (Page 11, lines 16-24.)

The cathode/anode discharging distance may be operated by an AC- and DC-mixed supply, for example, by a timed DC, or may be operated only by DC. Layers may be deposited reactively or non-reactively, preferably from electrically conducting target body material. As also illustrated diagrammatically by the pipe system 33, the magnetic circuit housing 4 and the target body 1 are medium-cooled, preferably water-cooled. (Page 12, lines 1-8.)

A working gas (for non-reactive atomization coating, this gas may be a noble gas or for reactive atomization coating, this gas may be a noble gas with a reactive gas, the latter reacting with the material atomized from the target body 1, and the coating taking place by a reaction product) is preferably discharged by a schematically illustrated pipe system 35 in the core 15 via outlet openings 37 into the process space as shown by the radially directed arrows. (Page 12, lines 9-17.)

Issue

The sole issue related to patentability is whether Claims 35-37, 44 and 45 fail to comply with 35 USC § 112, ¶ 1 because the subject matter thereof was not

originally described in the specification in such a way as to enable one skilled in the relevant art to make and/or use the invention. No rejection of the claims has been made under 35 USC § 132, although an objection to the Specification has been made under that statutory provision.

Applicants submit that their claims are fully compliant with 35 USC § 112, ¶ 1 and that the rejection should be reversed. A reversal would also overcome the new matter objection to the Specification as well as obviate and the contention that the present application should be a continuation-in-part application.

Grouping of Claims

Claims 35-37, 44 and 45 stand together for purposes of the sole issue in this appeal, with Claim 44 being the claim upon which this appeal can be decided.

Argument

As a starting proposition, we note that it is the Examiner's initial burden to establish a *reasonable* basis to question either the written description or the enablement requirements of 35 USC § 112, ¶ 1. The final rejection does not clearly delineate whether the rejection is based upon the written description, the enablement requirement, or both, as it is well settled that the written description and enablement requirements are separate and distinct from one another and have different tests. See, *In re Wilder*, 736 F.2d 1516, 1520, 222 USPQ 369, 372 (Fed. Cir. 1984). In either case, the Examiner has not made the requisite showing, although it would appear that enablement is implicated as the

Examiner contends that with regard to the relationship $0.2r_1 \leq d_0 \leq 0.54$ r, in Claim 44, "the disclosure as recited in the original application is not enabling for the claimed relationship."

Applicants will proceed, however, on the assumption that both requirements are implicated by the rejection. The test for determining compliance with the written description requirement is whether the disclosure of the application, as originally filed, reasonably conveys to the artisan that the inventors had possession at that time of the later claimed subject matter, rather than the presence or absence of literal support in the specification for the claim language. See, *Vas-Cath, Inc. v. Mahurkar*, 935 F.2d 1555, 1563-64, 19 USPQ2d 1111, 1116-17 (Fed. Cir. 1991). The test for enablement is whether one skilled in the art could make and use the claimed invention from the disclosure coupled with information known in the art without undue experimentation. See, *United States v. Telectronics, Inc.*, 857 F.2d 778, 785, 8 USPQ2d 1217, 1223 (Fed. Cir. 1988).

To the extent that the final rejection is based upon enablement, that rejection must be reversed because the Examiner did not consider or apply the relevant factors and make them of record. That is, in applying the above-noted enablement test, factors which must be considered in determining whether a disclosure would require undue experimentation include (1) the quantity of experimentation necessary, (2) the amount of direction or guidance presented, (3) the presence or absence of working examples, (4) the nature of the invention, (5) the state of the prior art, (6) the relative skill of those in the art, (7) the predictability or unpredictability of the art, and (8) the breadth of the claims.

See, *In re Wands*, 858 F.2d 731, 737, 8 USPQ2d 1400, 1404 (Fed. Cir. 1988), citing *Ex parte Forman*, 230 USPQ 546, 547 (Bd. Pat. App. & Int. 1986).

As made clear in *In re Marzocchi*, 439 F.2d 220, 223, 224, 169 USPQ 367, 370 (CCPA 1971):

> It is incumbent upon the Patent [and Trademark] Office, whenever a rejection on this basis is made, to explain why it doubts the truth or accuracy of any statement in a supporting disclosure and to back up assertions of its own with acceptable evidence or reasoning which is inconsistent with the contested statement. Otherwise, there would be no need for the applicant to go to the trouble and expense of supporting his presumptively accurate disclosure.

This has not been done in the present case. The disclosure, and all that is inherent therein to one skilled in the art, remains unassailed with regard to the enablement requirement.

Likewise, with regard to the written description requirement, the final rejection does not adequately rebut the presumption that the now-claimed subject matter was reasonably conveyed to one skilled in this highly sophisticated art by the original disclosure. Despite the arithmetically simple derivation contained in the Declaration of Mr. Walter Haag (Appendix B), one of the inventors, showing where the claimed relationship is derivable from the original disclosure, the final rejection continues to repudiate that declaration on legally insufficient grounds.

The only "factual" basis for not giving the Haag Declaration persuasive and controlling authority appear to be that Equation (3) in that Declaration is not provided in the amendment to the Specification. Section 112, ¶ 1 contains no such requirement. However, Mr. Haag pointed out that the simple target taper

relationship of Equation (3), i.e., $d_0 = d_{113} - a$, where d_0, d_{113} and a are unquestionably described in the original disclosure, including what is also reasonably conveyed in Fig. 1. This is not a case where dimensions or scale solely shown in the drawing, which is part of the original disclosure, as acknowledged in *Vas-Cath, Inc. v. Mahurkar*, 19 USPQ2d 1111, 1116-17 (Fed. Cir. 1991), are being used to support a claim. To the contrary, it is relationships unambiguously described in the Specification and substantially shown in Fig. 1 that support the Equation (3) set out in the Declaration. Even though *Vas-Cath* makes clear that drawings alone might satisfy § 112, ¶ 1, applicants have pointed to the relationships described in their Specification to show how the taper/radius range is easily ascertained.

The final rejection, or actually the response to the request for reconsideration, generally asserts that there "are more relationships set forth in the declaration that [are not?] taught in the specification amendment of note [presumably the amendment of October 2, 2000]." The alleged failure to teach the target taper d_0 relationship to radius in Claim 44 is grounded on whether that relationship is "easily ascertained" given the original disclosure. Although we would submit that the relationship is very easily ascertained, as the Declaration demonstrates, even by a high school student with a basis understanding of plan geometry, "easily ascertained" -- to the extent that the final rejection wants the original disclosure to precisely match the claim terms -- is not the *Vas-Cath* test. That test involves reasonableness as viewed through the eyes of the skilled artisan, one who in this case is highly skilled and educated.

When viewed through those eyes, it is clear that the relationship of Claim 44 was inherent and reasonably conveyed to the person of ordinary skill. The importance of the atomization surface of the target body as defining the process space and the obtaining of preferred surface ratios were initially signaled by the original disclosure as were, e.g., relationships between the maximal thickness d_1 of the target body in relation to the target radius r_1; for a circular workpiece, between the maximal distance of the new atomization surface to the workpiece surface to be coated, d_{113}, and the workpiece diameter ϕ_{13}; and a target body radius, r_1, and the workpiece radius. Moreover, the original disclosure clearly established the relationship between the distance a and the maximal distance d_{113}.

The Examiner argues that there is no clear disclosure of d_0 in Fig. 1. There is, however, a clear disclosure of a relationship between d_{113} and a which applicants have chosen to call d_0, as a shorthand way of describing that relationship. This is not a new matter issue, merely nomenclature, i.e., what one skilled in the art would designate from certain of the illustrated parameters.

The presence or absence of an undimensioned "gap" in Fig. 1, which merely shows what amounts to a dividing line or small space (about 0.5 to 1 mm in actual practice) between the target body 1 and frame 9 to indicate electrical insulation (as described at page 4, lines 5-13 of the Specification), is irrelevant. It is the more substantial difference between the target body's maximal thickness d_1 of the target body and the distance a which is the dimension spanned by the interior surface F_9 of the receiving ring 9. The so-called gap is merely shown to reflect an inevitable small space that exists as a practical

matter for electrically insulating the receiving frame and target arrangement that operate at different electrical potential. (See also page 7, lines 19-23 of the Specification.) The gap is sized to prevent plasma burning within the insulation gap. For that reason, the gap is kept very small. To one of ordinary skill in the art, the relationship of the taper d_0 and the cylindrical target body radius r_1 would not be affected in any meaningful way by the negligible gap. Questions raised regarding the "gap" are not germane in any real sense to the basic disclosure and would not have led, as Mr. Haag's Declaration clearly demonstrates, to a taper and radius relationship other than as set forth in Claim 44.

Accordingly, reversal of the rejection of Claims 35-37, 44 and 45 is earnestly solicited.

If necessary to effect a timely response, this paper should be considered as a petition for an Extension of Time sufficient to effect a timely response, and please charge any deficiency in fees or credit any overpayments to Deposit Account No. 05-1323 (Docket #622/42052DV).

Respectfully submitted,

September 5, 2002

James F. McKeown
Registration No. 25,406

CROWELL & MORING, LLP
P.O. Box 14300
Washington, DC 20044-4300
Telephone No.: (202) 624-2500
Facsimile No.: (202) 628-8844

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APPENDIX A
Claims on Appeal
U.S. Application No. 08/902,331

35. The target body according to claim 44 wherein there is valid

$$50 \text{ mm} \leq 2\, r_1 \leq 150 \text{ mm}$$

36. The target body according to claim 35 wherein there is valid

$$75 \text{ mm} \leq 2\, r_1 \leq 150 \text{ mm}$$

37. The target body according to claim 44 wherein the thickness of the body along periphery d_i is

$$d_i \approx 0.5\, r_1$$

44. Circular target body for a magnetron source, the target body comprising a cylinder-body with a central opening, one end face of said body being symmetrically concavely tapered towards the axis of said cylindrical body through said opening to thereby define a new atomization surface, F_1, in the form of a concave, substantially bell-shaped sputtering surface, a backside of said body being formed by a flat annular outer ring-surface and an inwardly recessed flat circular center surface, an amount of taper d_0 being defined by

$$0.2\, r_1 \leq d_0 \leq 0.54\, r_1$$

wherein r_1 is the radius of said cylindrical body.

45. The target body according to Claim 44, wherein the magnetron source comprises a magnetic circuit arrangement operable to generate a magnetic field over the atomization surface, including an anode arrangement, a receiving frame which extends around an edge of the target body and is electrically insulated with respect thereto, which receiving frame has a receiving opening for at least one workpiece to be coated, and the atomization surface and a surrounding non-atomized residual interior surface of the receiving frame being sized and arranged relative to one another such that a process space bounded substantially by the atomization surface of the target body and the surrounding non-atomized residual interior surface, F_9, of the receiving frame, except for the receiving opening for the at least one workpiece, satisfies the relationship $\leq$ 50% F_1, to minimize the surrounding non-atomized residual interior surface thereby to ensure, during an atomizing operation, a stable plasma discharge.

APPENDIX B

Attorney Docket: 622BA/42052DV
PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: PIUS GRUENENFELDER ET AL.

Serial No.: 08/902,331 Group Art Unit: 1753

Filed: APRIL 7, 1995 Examiner: G. Cantelmo

Title: MAGNETRON ATOMIZATION SOURCE AND METHOD OF USE THEREOF

DECLARATION OF WALTER HAAG

I, Walter Haag, declare and state as follows:

1. I am a named co-inventor in the above-identified application.

2. I am currently an employee of Unaxis Balzers AG, the assignee of this application. I have worked for the company, formerly known as Balzers AG for about 21 years.

3. My technical education was received at the Fachhochschule in Rüsselsheim, Germany, where I graduated from with a diploma in physical engineering. I am currently employed as a Manager R&D for coating sources.

4. My employment duties at Unaxis Balzers AG have been primarily in the design and development of sputtering equipment, including the design and development of magnetron atomization sources.

5. I have been named as an inventor in several U.S. and corresponding foreign patents in the sputtering field, among others U.S. Patent No. 5,733,419; 5,753,089; 5,997,697 and 6,068,742.

6. My technical training and professional work experience have given me first-hand familiarity with the level of ordinary skill of those designing and developing magnetron atomization sources prior to April 7, 1994. Based upon that knowledge, I can say without any qualification that one of ordinary skill in this art prior to April 7, 1994 would have been able to arrive at the target body taper range set forth in Claim 44 from our original disclosure using nothing more than basic computational skills and a basic understanding of geometry without any undue or unreasonable effort.

7. The attached Sketch A shows in simplified form the circular target body 1 shown in Fig. 1 of our above-identified application. In particular, the radius r_1 of the body is referenced at page 7, lines 12-14 and page 10, lines 11-14. Radius r_1 is also shown in Fig. 1. Likewise, the target body 1 also has a maximal thickness, d_1, as seen in Fig. 1 and also referenced at page 7, lines 12-14 of our disclosure. Of course, one of ordinary skill in the sputtering art will know that a "maximal" thickness related to the target body radius will also mean that it can have a lesser thickness at the edge.

8. Fig. 1 of the above-identified application and attached Sketch A both show the concave mirror shape of the new atomization surface F_1 as described at page 6 of our disclosure. The only parameter not originally designated by a letter or numeral in Fig. 1 is the amount of taper of that concave mirror shape 3b which was originally described as significantly thicker at its edge than at its center. We have merely referenced this taper in Claim 44 by the designation d_o and will now show how the range of values for d_o set forth in Claim 44 is easily ascertained from our original disclosure.

9. Page 9, line 15 to page 10, line 3 of our original Specification disclosed the following data without any question, namely

$$0.2\ \varnothing_{13} \leq d_{113} \leq 0.5\ \varnothing_{13} \qquad (1)$$

where d_{113} is, as seen in Fig. 1 the maximal distance between the new atomization surface to the surface to be coated. Inasmuch as $\varnothing_{13} = 2r_{13}$, then

$$0.4r_{13} \leq d_{113} \leq r_{13} \qquad (2)$$

The amount of the target taper d_o can be seen from Fig. 1 to be

$$d_o = d_{113} - a \qquad (3)$$

where a, a distance between the surface to be coated and the edge of the new atomization surface, is most preferably approximately 30% d_{113} as described at page 11, lines 14-15 of our disclosure. In other words, therefore,

$$d_o = d_{113} - 0.3\ d_{113} = 0.7\ d_{113} \tag{4}$$

whereby above equation (2) becomes

$$0.4\ r_{13} \leq \frac{1}{0.7} d_o \leq r_{13} \tag{5}$$

10. Page 10, lines 4-14 of our disclosure further teaches that r_1 is about 30% to 40% larger than the radius r_{13} of the workpiece to be coated. That is,

$$1.3r_{13} \leq r_1 \leq 1.4r_{13} \qquad \text{or} \tag{6}$$

$$r_{13\ min} = \frac{r_1}{1.4} \qquad \text{and } r_{13\ max} = \frac{r_1}{1.3} \tag{7}$$

Using the left-hand side of equation (5) as the lower limit and the right-hand side as the upper limit, equation (7) becomes

$$0.4\ r_{13\ min} \leq \frac{1}{0.7} d_o \leq r_{13\ max} \tag{8}$$

and

$$0.4 \frac{r_1}{1.4} \; 0.7 \leq d_o \leq 0.7 \frac{r_1}{1.3}$$

again, in other words,

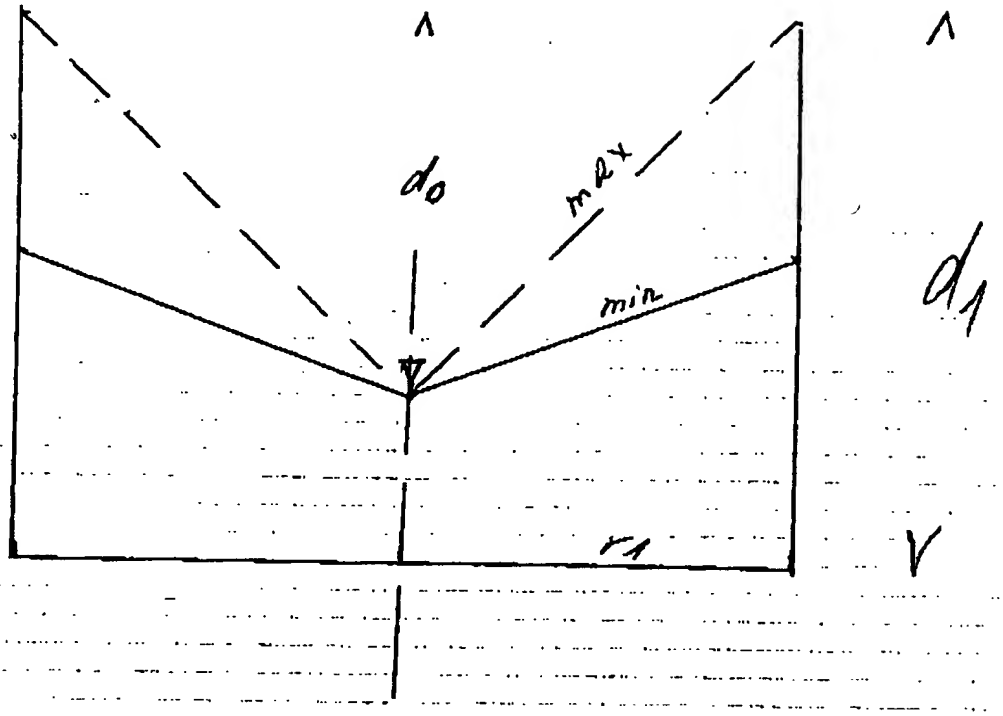
$$0.2 \; r_1 \leq d_o \leq 0.54 \; r_1$$

This taper range is that which is claimed in Claim 44.

Further declarant sayeth not.

Nov. 19th 2001
Date

W. Haag
Walter Haag



SKETCH A